Growing organic black beans in Veneta, Oregon

(Western Oregon, 17 miles west of Eugene)
https://sites.google.com/view/low-tech-farm-tools
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1. planting date: May 1-25, (typically May 5-15). Early plantings, ~ April 24 have longer growing season, potentially higher yield, less irrigation required, more weeds, greater risk of spring frost damage, and deer get fed earlier. Late plantings allow more weeds to emerge and tilled prior to planting, delays harvest and exposed to fall rain during harvest, and may require irrigation to germinate the crop. For organic beans, early planted beans will make some initial growth then wait until soil temperature warms up for the rhizobia to synthesize soluble nitrogen before making rapid growth. This slower growth and waiting for soil temperature to warm up expose beans to seedling root diseases, rhizoctonia, fusarium and pythium. Hence, there is no benefit of early planting without added nitrogen fertilizer. For conventional planting Baur (1) suggest April 16 to May 27 planting dates; seeding rate at 2.5 to 3 inches apart, 24-inch rows; 60-80 pounds of nitrogen, 80-120 pounds of phosphorous and 20-30 pound of sulfur fertilizer; and Eptam and Dinitro herbicides. The added nitrogen allows for rapid plant growth and early planting.
2. crop rotation:
    - summer bean > winter cover crop > summer bean > winter cover crop = bean year after year, with a winter cover crop to break the disease cycle. The cover crop cannot be beans but clover, vetch, fava and peas are acceptable (Steve Temple, UC Davis extension agronomist, personal communication). Over 10 consecutive years of summer beans and winter cover crop, showed no buildup of diseases in Veneta. However, consecutive planting for 10 years may select for weeds that can find a niche in that crop rotation. Winter cover crop is a mix of annual ryegrass and crimson clover for adding organic matter and nitrogen.
3. overseeding bean with a winter cover crop of crimson clover prior to last cultivation or last irrigation in mid to late July allows early establishment of cover crop. Clover cover crops (alsike, crimson, Persian, red and yellow), were established and grew to 4-10 inches tall at harvest time (September 15). The cover crops did not interfere with bean harvest when combined directly off the plant. Because overseeded cover crop are not tilled after bean harvest, winter weeds that emerged along with the overseed cover crop also grow in the bean field. Broadcast and till in annual ryegrass seeds after bean harvest. Fava and vetch can be used as cover crop, but seeds from volunteer fava and vetch can interfere with beans seed cleaning.
4. Fertilizer: lime, phosphorus, sulfur, boron and zinc and maybe molybdenum (?). There was an apparent bean response to molybdenum,

once. Subsequently, after applying molybdenum via irrigation injection, the apparent bean response to molybdenum was never seen again in 10 years; hence the apparent molybdenum response could not be confirmed.

5. Major weeds encountered at Veneta, Oregon:
    - nightshades (Solonaceae solanum): nightshade berries interfere with post harvest seed cleaning. Nightshade plant emerges in June- July. Flex tine cultivation in July will suppress nightshade weeds but does not completely eliminate it. Sweeps are less effective in suppressing nightshades between plant rows because blades are drawn farther away from the bean plants than tines.
    - wild mustard and radish (Brassicaceae Brassica and Raphanus): the 1-2-inch-thick radish head can jamb the combine draper belt/ feed system during harvest. Post harvest, wet seed pods can rot in drying bin and contaminate adjacent beans. Wild mustard and radish emerge throughout the growing season, from March to September. They are controlled but not eliminated with flex tine cultivator used in conjunction with rotary hoe and sweeps.
    - wild buckwheat (Polygonaceae Polygonum): the vines entangle bean plant and interfere with combining. Flex tine cultivator and rotary hoe remove young shallow rooted weeds.
    - smart weed (Polygonaceae Polygonum): compete for nutrient, light and water. It is removed with flex tine cultivator in conjunction with rotary hoe at early weed growth. If smartweed emerges later in the season, beans will shade out and stunt smart weed.
    - lambs quarter (Chenopodiaceae Chenopodium) competes for sunlight and nutrient. It is readily controlled by flex tine and rotary hoe
    - Canada thistle (Asteraceae Cirsium) tough perennial competitor that will outgrow and shade beans. See notes on Canada thistle control by mechanical cultivation here
6. Weed control: flex tine cultivator (Figure 1), rotary hoe (Figure 2), sweeps (Figure 3), and narrow strip rotary hoe with sweeps (Figure 4, 5) are synergistic. The flex tine cultivator and rotary hoe remove weeds in the plant row and between the plant row when bean plants are short; both can be used without regard for plant row. Flex tine cultivator scratches the surface ½ to 1 inch deep with staggered rows of tines for an effective 5/8 inch spacing between tines. Rotary hoes dig pits 1-3 inches deep spaced 2 ½ x 3 ½ apart; thus, deeper than flex tine cultivator but with less surface coverage. Sweeps remove everything in its path and cannot be used in the plant row. Mechanical cultivation is more effective in desiccating weeds with sunny and windy conditions. Variations of the following mechanical cultivation procedure were used on 14 acres of black beans to suppressed weeds, but not a complete elimination. (design for making a flex tine cultivator and narrow strip rotary hoe available at https://sites.google.com/view/low-tech-farm-tools)

- Pre emergence cultivation with flex tines; 1-2 passes at 6 mph ground speed, 3-5 days after planting. Bean seeds are below the tine depth, and emerge 7-14 days after planting. The flex tine cultivator removes weeds in direct path of the tines at the white root stage before emergence and young shallow rooted weeds. Alternatively, use rotary hoe at 8 mph ground speed for pre-emergence cultivation. The rotary hoe uproots weeds, loosen soil and breaks the soil-water capillary conductivity, desiccates shallow rooted weeds, including weeds not lifted out of the soil.
- First post emergence cultivation, use sweeps in conjunction with narrow strip rotary hoe 5-14 days after bean plant emergence, ground speed 2-3 mph. Sweeps remove weeds between plant rows and strip rotary hoe remove weeds in the plant row, loosen soil to desiccate weeds. Young bean plants are affected by the loosen soil, but they re-establish their roots more readily than shallow rooted weeds.
- Subsequent cultivations, alternate between flex tine cultivator, rotary hoe and sweeps. Use shallow depth of cultivation for early plant growth stage, and deeper cultivation when plants are more rooted.
- Last rotary hoe cultivation, 4-6-inch-tall beans; last flex tine cultivation, 8-inch-tall beans ~July 1 at ~3 mph ground speed; last sweep cultivation, ~75% canopy in late July.

7. Deer:
   - coyote reduce deer population; deer tend to leave the area, those that remain are fewer in number but not zero.
   - Wettable sulfur is somewhat effective as a deer repellant. It is an eye and nose irritant; and when eaten in sufficient quantity, causes stomach ache. Sulfur sprayed on leaves and soil is effective for a week and remains effective even after rain wash sulfur off leaves. However, deer remaining in the area will eat something else until the sulfurous odor subsides, or light breeze dilutes the odor, then eat beans. Sulfur is applied at a rate of ½ to 1 pound per acre (sulfur as a fungicide for beans is 3-10 pound per acre). Lime sulfur spray also works but is more expensive than wettable sulfur. Parenthetically, if the bean plant makes significant growth following sulfur spray, this indicates sulfur deficiency.
   - Hot chili pepper extract, blood meal and ‘Liquid Fence’ are somewhat effective, short duration and more expensive than sulfur.
8. Irrigation: three irrigations, each with 3 inches of water starting in late June to August 1. Last irrigation is 4 -5 weeks prior to expected harvest date to allow dry down of bean plants. No irrigation needed to germinate beans if beans are planted into moist soil in May.
9. Harvest: Allis Chalmers All-Crop combine can harvest the beans directly off the plants, without knifing and windrowing the beans prior to combining. To minimize bean splits during combining, reduce the

combine cylinder speed (~400 rpm) and use 1 concave bar (remove the second concave bar). Beans have indeterminate flowering; some pods are ready to harvest while late flowering pods are green. Depending on weather, there is a 10-20% loss from lodging, pod shattering, bean splits; additional loss from inclement weather. John Deere 40 combine also works, using low cylinder speed.

10. Weather (rain) is a limiting factor in growing dry beans in western Oregon: affecting planting date, early weed control, harvest and post harvest drying. Mature bean pods can tolerate 4-8 days of light rain; however, plant sags lower to the ground, making it difficult to harvest, increases diseases as well as weed re-growth. It almost always rains at least once during the 10 days of September harvest in Veneta, Oregon.
11. Post harvest drying. Beans are air-dried 2 months. One month of air drying is sufficient to dry beans. However, if there are nightshade berries mixed in the beans, then 2-3 months of air drying to shrivel the nightshade berries and winnow out the berries. (Figure 6 and 7).
12. Seed cleaning: when beans come off the combine, a 7/16-inch round hole screen is used as scalper to remove stems, pods and large debris; followed by winnowing, then drying. After 1-2 weeks of drying, beans are winnowed again, and more drying for 1-2 month before screen cleaning. Screens are a 21/64-inch diameter round hole; and 10/64 x ¾ inch slotted (oval) holes to remove split beans and smaller foreign material. Winnowing will remove some split beans, but the slotted screen is more effective in removing splits. Final cleaning prior to sales is a tumble in indent cylinder with a number 16 drum (16/64-inch indentation). Tumbling for ½ minute polishes the beans, kill any grain moth larva and egg, and lift out small beans, stray nightshade berries, vetch and Austrian peas.
13. Black beans will cross pollinate with pinto, kidney and other common beans (Ashworth, S 1991. Seed to Seed. Seed Savers Exchange, Decorah, Iowa). Experience from Veneta: seeds from cross pollinated black and pinto bean produce black speckled beans with tan background color; cross pollinated black and kidney bean is intermediate color, size and shaped bean.
14. Pinto bean has higher yield because of its vine growth habit, but more difficult to harvest directly off the vine (not a problem if bean plants are knifed and windrowed before combining). Kidney bean is easier to clean because its large size is significantly different from weed seeds and pods. Dark colored beans (black, pinto) hide cosmetic blemishes better than light colored beans; not a problem if beans are polished to remove blemishes. Soybean is the easier to grow because its strong upright stalk will support pods off the ground and shed rain better than common beans.

Mechanical cultivators

Figure 1. Flex tine cultivator used at pre-emergence until 8 inches tall bean plants. It scratches the surface ½ to 1 inch deep and remove shallow rooted plants including beans in the direct path of the tines. Cultivating beans at 8 inch tall will suppress nightshade and wild buckwheat; whereas sweeps cannot get as close to weeds near the plant row, and 8 inch beans are too tall for rotary hoe.

Figure 2. Rotary hoe used at pre-emergence until 4-6 inch tall bean plants. It digs pits 1-2 inches deep, spaced 2 ½ x 3 ½ inches apart; pulls weeds out, loosen soil and disrupt soil capillary water flow to desiccate shallow rooted weeds that are not pulled out. It works synergistically with flex tine cultivator.

Figure 3. Sweeps and mini disks are used 1 week after bean emergence until 75% canopy cover, whereas 6 inch beans are too tall for rotary hoe, and 8 inches beans are too tall for flex tine cultivator. It is most effective when used in conjunction with narrow strip rotary hoe to sweep and hoe in a single pass.

Figure 4. Sweeps and mini disks used in conjunction with narrow strip rotary hoe.

Figure 5 Closeup of sweeps, chisel and mini disk in the lead position followed by narrow strip rotary hoe.

Post harvest drying

Figure 6. Grain drying bins, made from 4ft x 4 ft totes, connected to a blower.

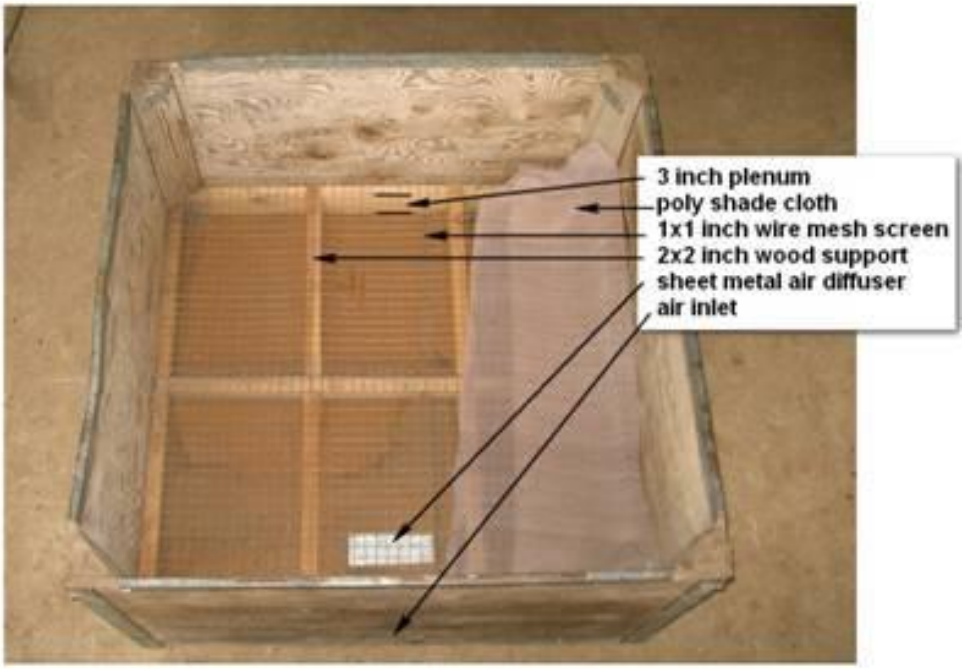

Figure 7. Top view of a grain drying bin, showing poly shade cloth (partly removed), 1 x 1 inch wire mesh screen, 2 x 2-inch wood support for wire screen and sheet metal air diffuser. Air enters at bottom plenum inlet, rise up through wire mesh screen and poly shade cloth, through bean holding area and exit.

Reference:

K Baur. Circa 1970. Dry Beans in the Willamette, a review and a look ahead. Pacific Supply Cooperative.

Trent, A, D Nolte, K Wagner. 2001. Comparison of Commercial Deer Repellants. USDA National Wildlife Research Center- Staff Publications Paper 572.